A NEW SPECIES OF STREAM-DWELLING HYLID FROG FROM NORTHERN QUEENSLAND

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Summary

DAVIES, M., & MCDONALD, K. R. (1979) A new species of stream-dwelling hylid frog from northern Queensland. *Trans. R. Soc. S. Aust.* **103**(7), 169-176, 30 November, 1979.

A new species of hylid frog, *Litoria lorica*, is described from near Thornton Peak in north Queensland. External morphology and cranial and post-cranial anatomy indicate a relationship with the *Litoria nannotis* species group. The species is sympatric with *L. nannotis*, *L. rheocola* and *L. nyakalensis* and lives in or near fast flowing streams.

Introduction

About one-third of the known frog fauna of the Australian continent has been described in the last decade (Tyler 1979a). Many of these descriptions arise from the re-examination of existing material, but a large proportion of new species has resulted from greater access to remote areas, and the intense activity generated by faunal surveys.

The faunal survey program of the Queensland National Parks and Wildlife Service has resulted already in the description of *Litoria longirostris* (Tyler & Davies 1977) and *Cophixalus concinnus* (Tyler 1979b). A further undescribed species was collected by J. W. Winter and R. G. Atherton at Alexandra Creek, near Thornton Peak in 1976. The species appears to be a member of the *Litoria nannotis* species group as defined by Liem (1974) and Tyler & Davies (1978).

Here we describe the new species and compare it with other members of the *L. nannotis* species group.

Materials and methods

The specimens reported here are deposited in institutions abbreviated in the text as follows: American Museum of Natural History (AMNH), British Museum of Natural History (BMNH), Queensland Museum (QM), Queensland National Parks and Wildlife Service (QP), South Australian Museum (SAM).

Methods of measurement follow Tyler (1968) whilst the abbreviations used in referring to various features employed in morphometric investigations are: E–N eye to naris distance; HL head length; HW head width; IN internarial span; S–V snout to vent length; TL tibia length. Osteological descriptions follow Trueb (1979). Cleared and stained material was prepared by a slight modification of the method of Davis & Gore (1947) whilst dried skeletal preparations were made following the methods cited by Tyler & Davies (1979).

The following specimens of the *L. nannotis* species group were examined for comparison with the new species. All were collected in Queensland.

Litoria nannotis (Anderson): QPA9-13, 2285-8, Mt Spec; QPA289, 418, 584, 815, 829, Crater Ntl Pk; QPA328, Josephine Falls; QPA792-3, Millstream Falls Ntl Pk; QPN14449-50, Charappa Ck; QPN14201-2, Alexandra Ck nr Thornton Peak; QPN14071, Russell River headwaters; QPN14132, Mt Lewis State Forest. *Litoria nyakalensis* Liem: QPA582, 809, 837, Crater Ntl Pk; QPN14282-3, 14285, 14289, Lake Eacham; QPN14077, Russell River headwaters, 17°24', 145°46'E; QPN14214, Alexandra Ck nr Thornton Peak; QMJ22629, Beatrice Ck, Palmerston Ntl Pk (Paratype). *Litoria rheocola* Liem: QPA292-3, Chena Camp; QPA294-7, Little Fork, Annan River; QPA392, Condoi Ck, Tully Mission Beach Rd; QPA423, Oliver Ck, (between Daintree and Cape Tribulation); QPA813, Millstream Falls; QPN14189-90, 17710, 14206, Alexandra Ck;

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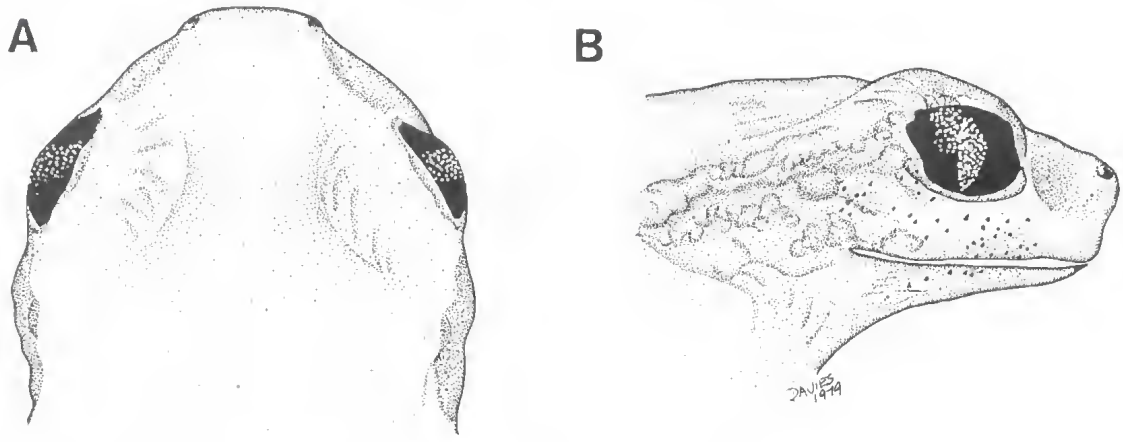

Fig. 1. A, dorsal and B, lateral views of the head of the holotype of *Litoria lorica*.

QPN14281, Lake Eacham; QMJ22644 (Paratype) Cape Tribulation.

Litoria lorica sp. nov.

FIGS 1–3

Holotype: QMJ36090, an adult male collected at Alexandra Creek near Thornton Peak (16°7′, 145°20′) Queensland by J. W. Winter and R. G. Atherton on 10.xii.1976.

Definition: A medium-sized, stream-dwelling species (female 32.9–37.3 mm; males 29.6–33.1 mm S–V length) characterized by poorly webbed fingers, fully webbed toes, moderately long hind limbs, males with spiny nuptial pads and accessory pectoral spines; ova large and unpigmented.

Description of holotype: Head evenly rounded, longer than broad (HL/HW 1.03); head length less than one-third of snout to vent length (HL/S–V 0.34). Snout short, truncate when viewed from above, and in profile (Fig. 1). Nostrils slightly more lateral than superior, situated almost at tip of snout. Distance between eye and naris greater than the internarial span (E–N/IN 1.10). Canthus rostralis well defined and strongly curved, loreal region strongly sloping. Eye prominent, its diameter greater than eye to naris distance by about one quarter. Tympanum small and indistinct. Well-developed glandular supratympanic fold.

Vomerine teeth on short transverse elevations slightly posterior to posterior edges of choanae. Tongue broadly oval and unnotched. Fingers long and slender, lacking lateral fringes and webbed at base (Fig. 2); in order of length 3 > 4 > 2 > 1. Terminal discs on fingers 2, 3 and 4 very well developed and twice width of lateral edges of penultimate phalanx. Disc on first finger reduced. Subarticular and palmar tubercles moderately developed. Supernumerary metacarpal tubercles present on all fingers. Extremely prominent prepollex. Densely spiny nuptial pad present. Forearm moderately robust.

Hind limbs moderately long (TL/S–V 0.59). Toes in order of length 4 > 3 > 5 > 2 > 1 (Fig. 2). Toes almost fully webbed, webbing on outer edge of fourth toes and inner edge of second and third toes reaching the base of the penultimate phalanx and continuing to disc as a broad fringe. Webbing reaches the discs on all other edges of toes. Subarticular tubercles prominent, and small supernumerary metatarsal tubercles numerous. A small oval inner metatarsal tubercle. No outer metatarsal tubercle. Narrow tarsal ridge.

Vocal sac absent.

Dorsum finely tubercular, more prominent tubercles being concentrated on upper eyelids and in tympanic region. Ventral surface granular on thorax abdomen and backs of thighs. Accessory keratinous, conical spines present in clearly demarcated zones upon ventral and lateral surfaces of upper arms and extending very slightly on to chest; a few smaller spines on loreal region, maxillary region and undersurface of mandible.

Dorsum dull slate in preservative. Ventral surface cream with a faint dusting of dark pigment on throat.

Dimensions of holotype: S–V 33.1 mm; TL 19.6 mm; HL 11.1 mm; HW 11.5 mm; E–N 3.4 mm; IN 3.1 mm; E 4.4 mm; T 1.2 mm.

Etymology: The specific name is derived from the Latin *lorica* "breast plate," in reference to the accessory pectoral spines on the male.

Variation

There are nine paratypes: AMNH 103747, (immature ♀), BMNH 1979.7 (adult ♂), QMJ 36091–2 (adult ♂ & adult ♀), SAM R17351 (adult ♀) collected with holotype; QMJ 36093, SAM R17348, 17350 (3 adult ♂♂) (SAM R17348 cleared and stained), 11.xii.1976, type locality; SAM R17349 (adult ♂) 9.xi.1976, type locality. All specimens were collected by J. W. Winter and R. G. Atherton.

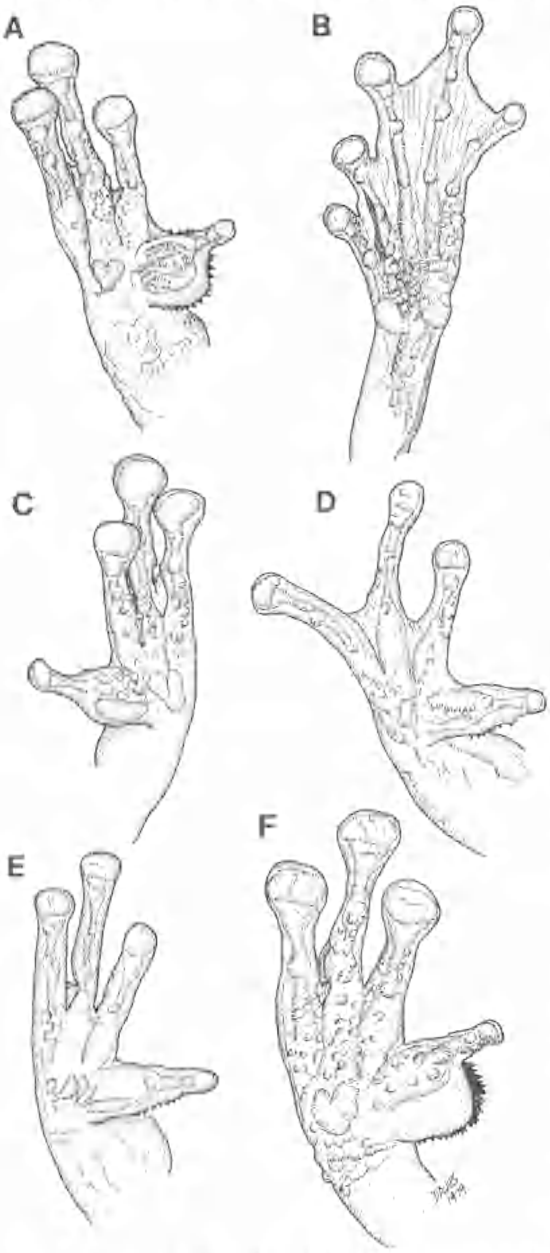

Fig. 2. A, hand and B, foot of *Litoria lorica*, holotype; C, hand of female *L. lorica*, SAM R17351; D, hand of male *L. rheocola* QPA837; E, hand of male *L. nyukulensis* QPA809; F, hand of male *L. nannotis*, QPA815.

The adult males measure 29.6–32.2 mm S–V and the females measure 32.9–37.3 mm S–V. The diameter of an unpigmented egg in the body cavity of SAM R13751 is 2.3 mm. Hind limbs are moderately long and variable (TL/S–V 0.55–0.62). Head width/head length ratios vary from 0.94–1.03. Head length to snout–vent length ratios range from 0.30–0.37 and E–N/IN ratios from 0.85–1.19.

Morphological variation is restricted to degree of distinctness of the tympanum (barely discernible in most of the paratypes) and degree of pigmentation of the gular area, ranging from moderately dense in the gravid female SAM R17351 to barely present in some of the male paratypes.

Forearms of males are more robust than those of females. A well-developed prepollex is present in females as well as males (Fig. 2).

Osteology

Skull moderately robust with moderately well ossified neurocranium (Fig. 3). Moderately large portion of sphenethmoid ossified slightly anteriorly to level of palatines and posteriorly extending about half length of orbit in ventral view. Sphenethmoid does not make bony contact with nasals. Prootic completely fused with exoccipital. Exoccipital not ossified dorsomedially. Crista parotica well developed, short, stocky and laterally barely articulates with slightly expanded otic ramus of squamosal. Frontoparietal fontanelle moderately extensive being overlapped irregularly laterally by moderately slender frontoparietals which extend about two-thirds length of orbit. Orbital edges of frontoparietals straight. Anterior margin of frontoparietal fontanelle formed by sphenethmoid at level slightly less than anterior one-third of length of orbit. Posterior margin undefined owing to absence of medial prootic ossification. Nasals moderately large, widely separated medially, with slenderly acuminate maxillary processes not articulating with deep pars facialis of maxillaries. Palatines moderately long, slightly ridged, expanded slightly laterally, tapering medially to terminate on lateral extremities of sphenethmoid anteriorly

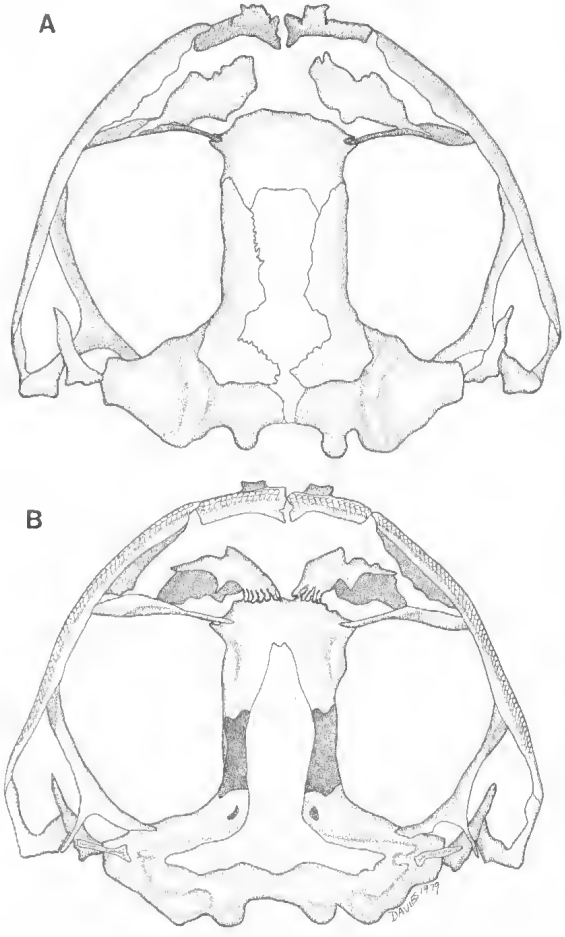

Fig. 3. A, dorsal and B, ventral views of the skull of *Litoria lorica*, SAM R17348.

to level of cultriform process of parasphenoid. Parasphenoid robust with broad, subacuminate, cultriform process and short, moderately broad alary processes, directed slightly posterolaterally and not overlapped by medial rami of pterygoids.

Pterygoid moderately developed with very slender acuminate posterior process. Anterior process in short contact with palatal shelf of maxillary at a level almost three-quarters anteriorly of length of orbit and medial arm moderately long and acuminate. Quadratojugal moderately robust and fully articulated. Squamosals moderately robust; zygomatic ramus slightly longer than otic ramus. Maxillary and premaxillary dentate. Tiny preorbital process on pars facialis of maxillary. Alary process of premaxillaries bifurcate, directed anterolaterally. Palatine processes of premaxillaries moderately well developed, curved posteromedially but do not articulate with each other.

Prevomers reduced anteromedially; alae form anterior and medial margins of choanae. Dentigerous processes moderately short bearing 6–7 teeth and horizontally oriented. Bony columella present.

Pectoral girdle arciferal and robust. Omosternum and xiphisternum present; clavicles slender and abut medially. Scapula slightly shorter than clavicles.

Suprascapula about two-thirds ossified. Humerus greatly expanded with well-developed dorsal and ventral crests.

Eight procoelous non-imbricate presacral vertebrae. Medial dorsal ossification incomplete on presacral I and II. Relative widths of transverse processes: III = Sacrum > IV = II > V = VI = VII = VIII. Sacral daipophyses moderately expanded, ilia extend half way along their length. Urostyle bicondylar with dorsal crest extending for about one-half its length.

Phalangeal formula of hand: 2, 2, 3, 3. Distal tips of terminal phalanges clawed. Very large bony prepollex. Flange present on adjacent metacarpal (I). Phalangeal formula of foot: 2, 2, 3, 4, 3. Tiny bony prehallux. Intercalary structures cartilaginous.

Comparison with other species

(a) *External morphology*: The medium size, slight finger webbing, extensive toe webbing, dull colouration, spiny nuptial pad, lack of vocal sac and large unpigmented ova are a combination of features exhibited by members of the *Litoria nannotis* species group viz. *L. nannotis*, *L. nyakalensis* and *L. rheocola*. *L. lorica* is undoubtedly a member of this species group.

The species can be distinguished from *L. nyakalensis* and *L. rheocola* by the presence of accessory pectoral spines in the male, the indistinct tympanum and the enlarged prepollex (Fig. 2). It can be distinguished from *L. nannotis* (the species to which it seems to be most closely related) by its smaller size (*L. nannotis* male S–V 40.1–53.2 mm, female S–V 46.3–56.0 mm), its truncate snout (Fig. 6) and the terminal position of the nares. In addition, *L. nannotis* males have more accessory spines in the head region, and on the forearm and thighs, and have a more robust forearm than *L. lorica*.

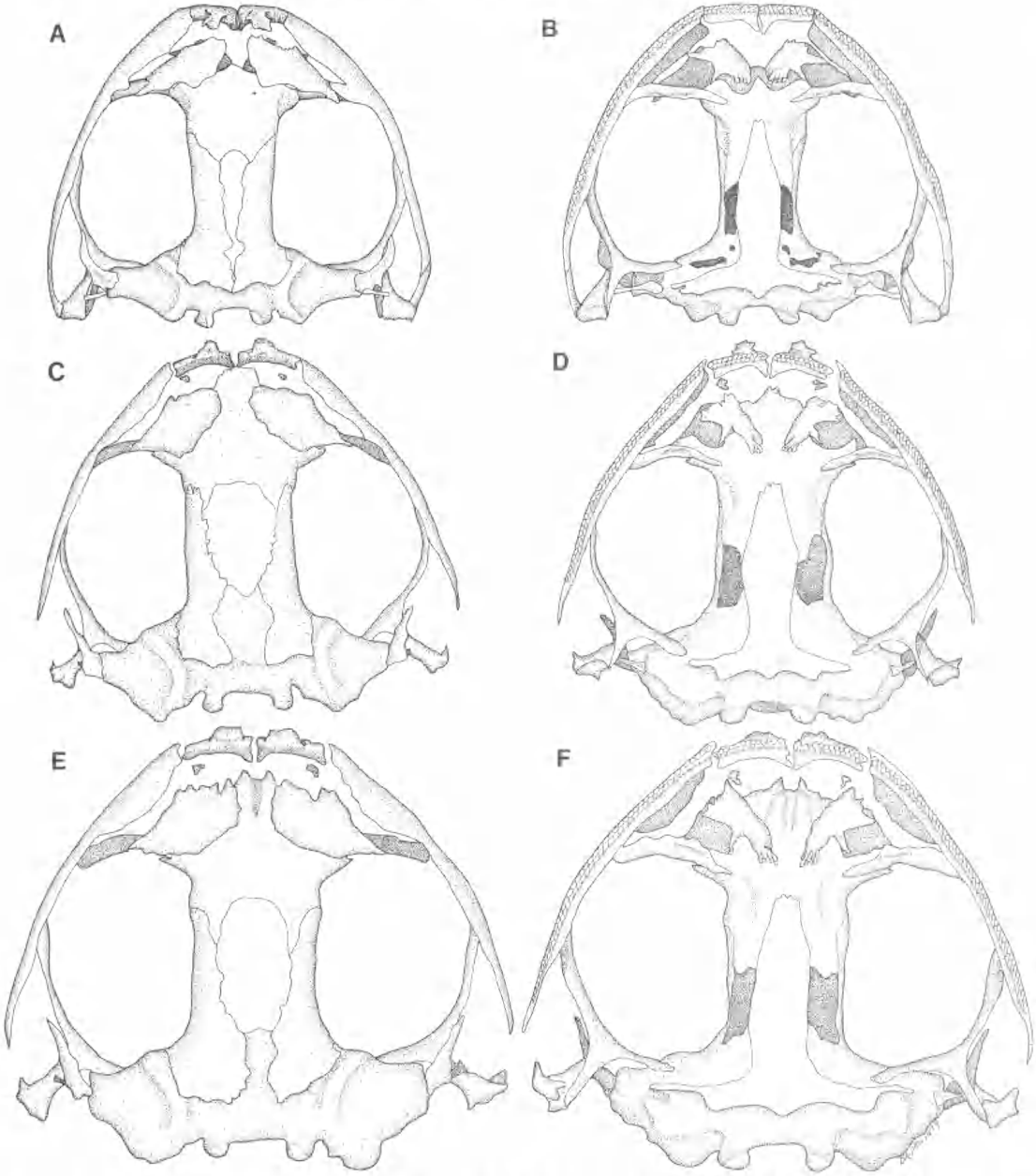

Fig. 4. A, dorsal and B, ventral views of the skull of *Litoria nannotis*, NP N14312; C, dorsal and D ventral views of the skull of *L. rheocola*, NP N14281; E, dorsal and F, ventral views of the skull of *L. nyakalensis*, NP N14284.

(b) *Osteology*: The skulls of *L. nannotis*, *L. nyakalensis* and *L. rheocola* are illustrated in Fig. 4. *Litoria lorica* can be distinguished from *L. nannotis* by reduced ossification of the neurocranium, the anterodorsally projecting alary processes of the premaxillaries (accounting for the more truncated snout shape in *L. lorica*), the lack of a pronounced preorbital process on the pars facialis of the maxillary, larger exposure of the frontoparietal foramen, the stockier crista parotica, the longer dentigerous processes of the prevomers and the very slender medial extremities of the palatines.

Postcranially, *L. nannotis* differs from *L. lorica* in having poorly expanded sacral diapophyses and the relative width of the

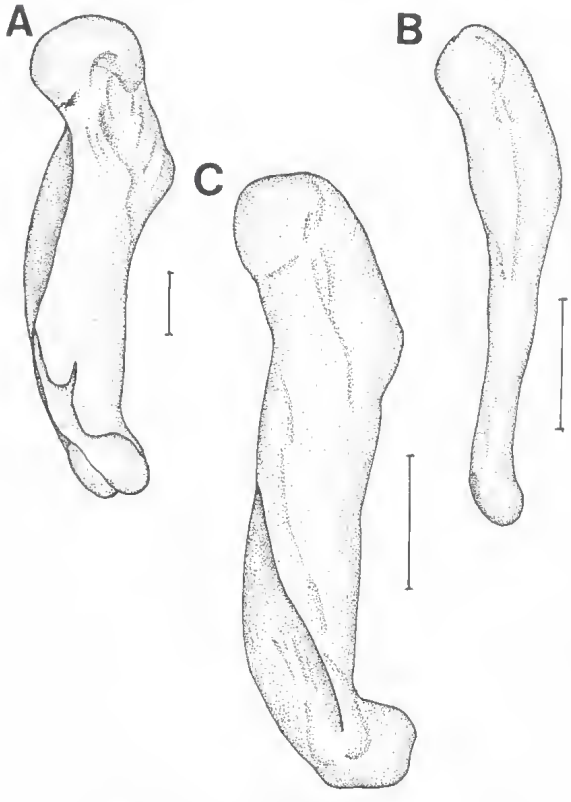

Fig. 5. Lateral view of humerus of A, male *Litoria nannotis*, B, male *L. rheocola* and C, male *L. nyakalensis*. Scale bar = 2 mm

transverse processes of the presacral vertebrae of III > Sacrum > IV > II > V = VI = VII = VIII.

The bony prepollex of *L. nannotis* is larger than in *L. lorica* and a number of flanges are present on the adjacent metacarpal compared with the single flange in *L. lorica*. Presence of humeral flanges dorsally and ventrally in *L. nannotis* (Fig. 5) is similar to the condition in *L. lorica* although these are more pronounced in the former species.

L. lorica differs from *L. rheocola* in having reduced ossification of the neurocranium, no contact between sphenethmoid and nasals, an elongate frontoparietal foramen, a complete quadratojugal, longer dentigerous processes of the prevomers and slender medial extremities of the palatines.

Postcranially, medial separation of the coracoids is less in *L. lorica* than in *L. rheocola*. Humeral flanges are poorly developed in *L. rheocola* (Fig. 5) and there is no flange on the adjacent metacarpal to the narrower bony prepollex. Relative widths of the transverse processes of the presacral vertebrae in *L. rheocola* are III > Sacrum = IV > II > V = VI = VII = VIII. The intercalary structures are ossified.

L. lorica can be distinguished from *L. nyakalensis* by reduced ossification of the neurocranium, absence of nasal contact with the sphenethmoid, an elongate frontoparietal foramen, longer dentigerous processes of the prevomers and slender medial termination of the palatines.

Postcranially, *L. lorica* and *L. nyakalensis* are similar with comparably developed humeral and metacarpal flanges and prepollices. The relative widths of the transverse processes of the presacral vertebrae in *L. nyakalensis* are III > Sacrum > II > IV > V = VI = VII = VIII. Intercalary structures are bony.

Larval morphology: The tadpole is unknown but the habitat preference of the adult indicates that it is probably a torrent-adapted form.

Habitat: The type series was collected on granite boulders in notophyll vine forest in the splash zone near turbulent, fast-flowing water. At the type locality *L. lorica* is sympatric with *L. nannotis*, *L. rheocola* and *L. nyakalensis*.

L. nannotis is usually found in the splash zone of rapids and waterfalls, but some specimens of both sexes have been collected on trees away from these areas. *L. nyakalensis* is usually found on branches overhanging streams, rarely on rocks, whilst *L. rheocola* is found on rocks and sometimes on overhanging branches near broken water.

Differing habitat preferences are exhibited by each of the four species although *L. nannotis* and *L. lorica* seem to exhibit the least separation. Further data should clarify this situation.

Distribution: *L. lorica* has been collected only at the type locality of Alexandra Creek near Thornton Peak.

The Litoria nannotis species group

Liem (1974) discussed the three species of the *L. nannotis* group then known. With the description of *L. lorica* and further data now available to us on the other members of the group, some additions to Liem's descriptions are necessary.

On a number of morphological and osteological criteria the group falls naturally into two species pairs: *L. nannotis* and *L. lorica*, and *L. rheocola* and *L. nyakalensis*; these fea-

tures include expansion of the discs (Fig. 2) secondary sexual characters, condition of the quadratojugal (Fig. 4) and intercalary structures. Whilst there is little difficulty in separating members of the former pair from each other and from the other pair, and the males of the second pair from each other, preserved females and non-breeding males of *L. rheocola* and *L. nyakalensis* are difficult to distinguish on external morphology alone.

A great deal of intraspecific variation occurs in many characters. For example, live specimens of *L. nyakalensis* are usually, but not always, pinkish on the ventral surface, and this colouration invariably disappears in preservative. Head shape varies slightly within the group (Fig. 6) but state of preservation can distort this character. Hand and foot webbing show slight differences between the species, but again intraspecific variation occurs. The tympanum is generally indistinct or not visible externally in *L. lorica* and *L. nannotis*, whereas in *L. rheocola* and *L. nyakalensis* it is usually distinct.

Vocal sacs are absent in all members of the species group, but males of *L. rheocola* and *L. nyakalensis* are capable of depressing the submandibular region during vocalization (M. J. Tyler, pers. comm.).

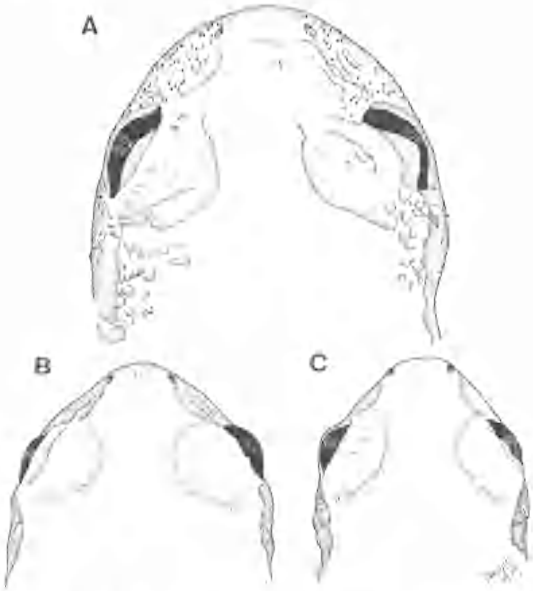

Fig. 6. Dorsal view of head of A, *Litoria nannotis*, B, *L. nyakalensis* and C, *L. rheocola*.

The one morphometric measurement that Liem used to distinguish members of the group —the relationship between eye to naris distance and internarial span was found to be inconsistent in the series of frogs examined by us (*L. nannotis* E-N/IN 0.84–1.24, *L. rheocola* 0.86–1.15, *L. nyakalensis* 0.88–1.35). However, we find that the head length to head width ratio separates *L. rheocola* from *L. nyakalensis*.

Osteological comparisons are between males because females of *L. nyakalensis* have not been available to us for study. Many of the osteological features separating *L. rheocola* and *L. nyakalensis* (such as development of humeral crests and metacarpal flanges, associated with the development of the forearm and prepollex) may be sexually dimorphic.

The following is a key to the species group.

1. Snout truncate; nostrils terminal; S–V < 40 mm 2
   Snout rounded; nostrils opening laterally, slightly posteriorly to end of snout; S–V > 40 mm ..... *L. nannotis*
2. Nuptial asperities spinous; accessory spines absent; tympanum usually distinct; prepollex not greatly enlarged; moderately large discs; intercalary structures bony 3
   Nuptial asperities spinous; accessory spines on pectoral region; tympanum usually indistinct; prepollex enlarged; discs large; intercalary structures cartilaginous ..... *L. lorica*
3. Nuptial spines fine; nuptial asperities small; ventral surface of posterior portion of body usually cream in life; HL/HW > 1.06 ..... *L. rheocola*
   Nuptial spines coarse; nuptial asperities moderately large; ventral surface of body usually cream with a reddish tinge in life; HL/HW < 1.06 ..... *L. nyakalensis*

Acknowledgments

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